

INSTALLATION MANUAL OF TML BTM BOLT STRAIN GAUGES

BTM Bolt Strain Gauges

In case that strain gauges can not be bonded on the shaft surface of a bolt, the BTM gauge is embedded into a hole drilled at the center of bolt head with A-2 adhesive to measure the axial strain of the bolt on tightening. By calibrating the gauge embedded into the bolt, you can find accurate tightening axial force of the bolt.

1 Specifications

Type	Gauge (mm)		Base (mm)		Gauge Center		Resistance (Ω)	Hole Dia. (mm)
	Length	Width	Length	Width	a	b		
BTM-1C	1	0.7	5.6	1.4	1.8	3.8	120	ϕ 1.6
BTM-6C	6	1.0	12.0	1.7	5	7	120	ϕ 2.0

Gauge lead : Polyurethane covered copper wire ϕ 0.14 80mm long
 Applicable bolt : Sectional area loss of bolt due to drilling should be within 5%.
 Operating temperature : $-10 \sim +80^{\circ}\text{C}$
 Strain limit : 5000×10^{-6}

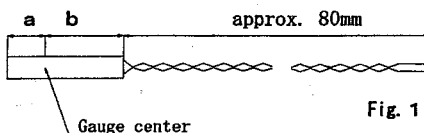


Fig. 1

2 Drilling Bolt

- ① Hole diameter BTM-1C ϕ 1.6mm BTM-6C ϕ 2.0mm
- ② Depth When the gauge is embedded, A clearance between the end of the gauge and the bottom of hole should be 3~5mm.

Ex. : In case the gauge center is 30mm from the top of the bolt head,

BTM-1C $a \Rightarrow 1.8\text{mm}$ $30 + 1.8 + 3 \sim 5 = 34.8 \sim 36.8\text{mm}$

BTM-6C $a \Rightarrow 5\text{mm}$ $30 + 5 + 3 \sim 5 = 38 \sim 40\text{mm}$

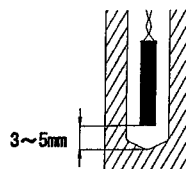


Fig. 2

3 Cleaning of Inner Hole

- ① Cleaning with solvent (Acetone, etc.)

Wash out drilling oil and dust with solvent through a syringe.

- ② Wiping off

Remove the remainder thoroughly by a solvent-dampened tissue which is rolled on a drill bit. Repeat till the tissue is not contaminated.

- ③ Removal of solvent

Remove the remaining solvent in the inner hole with a clean tissue, etc.

- * If drilling oil, dust and solvent remain in the hole, curing failure of adhesive may occur.
- * Also clean the outside of the bolt such as head and axle.
- * Immediately after washing, embed the gauge to avoid contamination by a film of oxide and soil.

4 Embedment Position (Depth)

- ① Embedment should be made at a position where variation in the section is less.
Embedment into the thread portion, bolt head or the bottom of a hole is badly influenced by the form of the section.

Image drawing

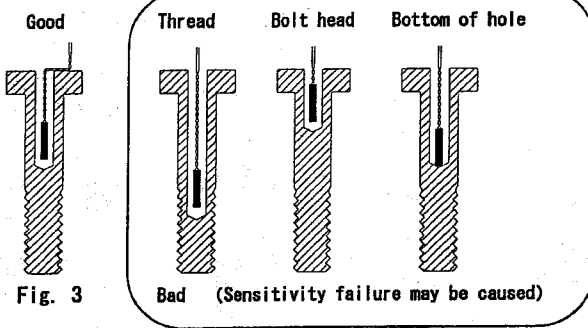


Fig. 3

- ② Determine an embedment position precisely and measure the embedment length.
③ Mark the gauge leads according to the length.
④ Bend the gauge leads rectangularly at the mark without injuring the insulation material..

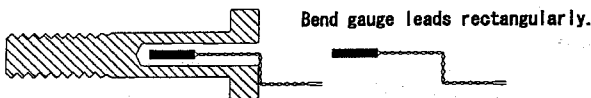


Fig.4

5 Mixing Adhesive

- ① Mixing ratio Drug A : Drug B = 10:1 by weight. Use the proper amount.
② Mixing
Mix well.
③ Heating
Warm the mixed adhesive by heat gun, etc. to remove air-bubbles and reduce the viscosity.
The mixed adhesive can be used for 2 - 3 hours.

* For detail, refer to the installation manual of the A-2 adhesive.

6 Preliminary heating

Heat the adhesive and bolt at 50 ~ 60°C for 30 minutes.

Adhesive : Keep fluid by reducing the viscosity. Removing bubble when mixing.

Bolt : Keep the same temperature as the adhesive to maintain the fluidity of the adhesive.

Continues overleaf

7 Pouring of Mixed Adhesive

① With use of syringe

- Enter the mixed adhesive into the syringe.
 - Insert the syringe to reach the bottom of the drilled hole.
 - Apply the mixed adhesive into the hole from the bottom fully.
- Take care not to produce air bubbles in the hole by adjusting the pulling-up speed of the syringe and pouring speed. When drawing up the syringe from the adhesive, take care not to make air bubbles remain in the hole.
- * A specific needle of 1.8mm dia. is available for embedding BTM-6C, not for BTM-1C.

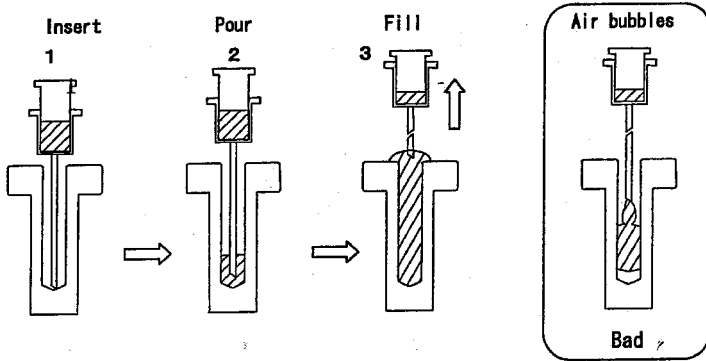


Fig. 5

② With use of vacuum pump

- Make a fence using vinyl tape around bolt head for adhesive pond.
- Pour the mixed adhesive. (For example, proper quantity should be 4 to 5 grams for a drilled hole of 2.0mm in diameter and 50mm in depth.)
- Put bolt into desiccator and create a vacuum for 15 to 20 minutes to get a level at 1 to 10Pa. The time to create vacuum depends upon desiccator volume and pump but vacuum work must be completed within 30 minutes in respect of pot life.
- After completion, remove the fence, and take off an excess adhesive.

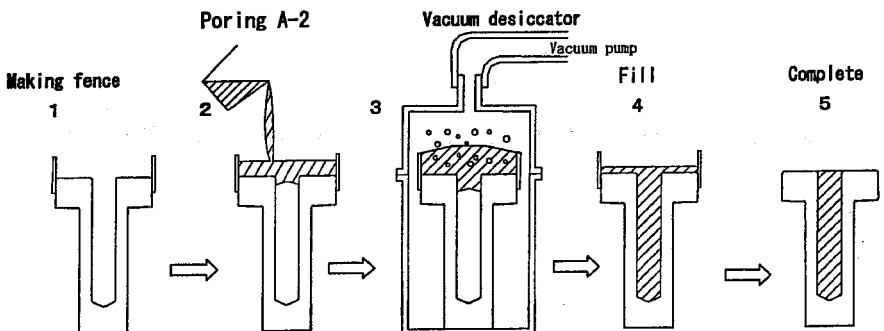


Fig. 6

8 Inserting Gauge

- ① Apply the mixed adhesive to the bolt gauge.
- ② Insert the gauge into the hole to put the bent part of gauge leads on the bolt head.
 - The gauge should be placed at the center of hole. Take care not to bend or place the gauge eccentrically or at the bottom.
 - When inserting the gauge, take care not to develop air bubbles.
- ③ Allow the adhesive to cure for 12 hours at room temperature. (In this state, the adhesive does not harden.)

Image Drawing
Good

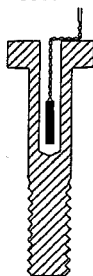
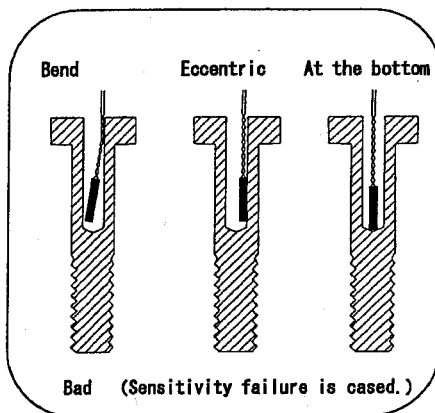


Fig. 7



9 Hot Curing

Cure with the bolt standing in electric furnace for 3 hours at 140°C.
Temperature should be raised after placing the bolt in the furnace.

- * Quick temperature elevation should be avoided; otherwise air bubbles or crack will occur.

10 Connection

After cooling the bolt, wire the gauge to instrument for measurement.



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